



The genus *Paraplotes* Laboissière, 1933 in Taiwan, a speciose group with brachelytrous females (Coleoptera: Chrysomelidae: Galerucinae)

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Abstract

Taiwanese members of the genus *Paraplotes* comprise a group of species that are not distinguishable based on external morphology but are diagnosed using distributions, aedeagal, and gonocoxal morphologies. Females of all species are brachelytrous. The group includes one previously described species, *Paraplotes taiwana* Chûjô, 1963, and nine new species, *P. cheni* sp. nov., *P. jengi* sp. nov., *P. meihuai* sp. nov., *P. tahsiangi* sp. nov., *P. tatakaensis* sp. nov., *P. tsoui* sp. nov., *P. tsuenensis* sp. nov., *P. yaoi* sp. nov., and *P. yuae* sp. nov. Diagnostic characters and hind wings of both sexes are illustrated. Models of speciation for the high diversity of *Paraplotes* in Taiwan are discussed. A novel hypothesis for brachelytrous leaf beetles occurring in tropical forest habitats (selva) is proposed.

Key words: Leaf beetles, taxonomy, physogastry, brachyptery, nocturnal behavior

Introduction

The genus *Paraplotes* Laboissière, 1933, consists of small sized, broad, parallel-sided galerucines, with one pair of longitudinal ridges on the elytra extending from the lateral angles. Some species of this genus have been confused with another genus, *Japonitata* Strand, 1935 (Zhang *et al.* 2008), probably the elytral ridges occur in both. However, *Paraplotes* is easily separated from *Japonitata* by the closed anterior coxal cavities and the margined basal border of the pronotum (anterior coxal cavities open and basal border of the pronotum unmarginated in *Japonitata*).

Paraplotes includes few species and seems rare in the historical museum collections. Zhang *et al.*, (2008) listed eight species in this genus: *Paraplotes frontalis* Laboissière, 1933 and *P. rugosa* Laboissière, 1933 were described from Vietnam based on single male specimens; four species are described from China: *P. clavicornis* Gressitt & Kimoto, 1963 based on five type specimens, *P. antennalis* Chen, 1942 based on one female type, *P. rugatipennis* (Chen & Jiang, 1986), and *P. semifulva* (Jiang, 1989), each based on one male type. *Paraplotes taiwana* Chûjô, 1963 was described from Taiwan based on one male type. *P. nepalensis* Medvedev, 1998 (in Medvedev & Sprecher-Uebersax 1998) was described from Nepal based on four types. One additional species occurs in Indonesia: *P. granulate* Medvedev, 2008, based on five female types.

The Taiwan Chrysomelid Research Team (TCRT) was founded in 2005 and is composed of 10 members. All of them are amateurs interested in making an inventory of all chrysomelid species in Taiwan. Basic bionomics of Taiwanese populations can be summarized as follows: adults are nocturnal and closely associated with the host plants—various species of Urticaceae (*Pilea* spp. and *Lecanthus peduncularis*). Effective collection is possible by searching for adults on host plants at night. More than 500 specimens have been collected throughout Taiwan by members of the TCRT. This taxonomic revision demonstrates the diversity of *Paraplotes* in Taiwan.

Material and methods

Most adults of *Paraplotes* are nocturnal in Taiwan. They appear on host plants at night, especially on *Lecanthus peduncularis* (Fig. 2) and various species of *Pilea* (Urticaceae), including *Pilea rotundinucula*, *P. aquarum* subsp.

brevicornuta, and *P. melastomoides*. Those plants occur in wet environments and often grow along the edges of forests, roads (Fig. 1), walking trails, and rivers. Because these environments are easily accessible, collecting adults is not difficult by searching on the host plants at night.

For laboratory rearing, females were put into small glass containers (diameter 142 mm, height 50 mm), together with several shoots of the host plant. Wet tissues were also kept inside the container to maintain high humidity. When mature larvae began searching for pupation sites, they were transferred to smaller plastic containers (diameter 90 mm, height 57 mm) filled with soil (80% of container volume).

A substantial collection of *Paraplotes* at the National Museum of Natural Science, Taichung (NMNS) includes specimens collected by Malaise traps each two months from 2009–2011. These data could reflect the phenology of adults.

For the preparation of genitalia drawings, the abdomen was separated and boiled in 10% KOH solution, followed by washing in distilled water. Genitalia was then mounted on slides in glycerin and studied and drawn using a Leica M165 stereomicroscope. For detailed examination a Nikon ECLIPSE 50i microscope was used.

For delimiting the variability of diagnostic characters, at least three pairs of each species were examined. When one species were collected from more than one locality, at least one pair collected from each locality was examined. Females are associated with a distinct species based on localities where they were collected.

Specimens examined are deposited in the following collections:

BPBM	Bernice P. Bishop Museum, Hawaii, USA [Shepherd Myers];
NMNS	National Museum of Natural Science, Taichung, Taiwan [Ming-Luen Jeng];
TARI	Taiwan Agricultural Research Institute, Wufeng, Taiwan;

Paraplotes taiwana species group

Differential diagnosis. Males are similar to *P. semifulva* with filiform antenna, but this group is characterized by the brachelytrous female with the combination of the following characters: females typically physogastric and brachypterous (Figs 82–91), elytra convex medially; spermatheca with tubular receptacle little swollen and hardly separated between receptacle and pump; pump extremely curved; proximal spermathecal duct short; gonocoxa with seven setae, base variable; ventrite VIII well sclerotized, apically widened, apical margin truncate, with dense setae along apex, spiculum slender.

Notes. Brachelytrous females of *Paraplotes* was not reported before. In fact, species with brachelytrous females and winged males are previously only known to occur to one neotropical galerucine genus, *Metacycla* (Beenen & Jolivet 2008).

Biology. Adults are typically nocturnal. They start crawling up onto host plants at sunset. Feeding (Fig. 3) and copulation (Fig. 4) occur on the host plants (Urticaceae) at night. Females prefer to deposit eggs on roots of plants (Figs 4 & 5). Larvae feed on young leaves and soft shoots (Fig. 7). Mature larvae (Fig. 8) leave the host plant and burrow into the soil. They build chambers underground for pupation. Duration of immature stages is typically less than one month.

An unusual exception was observed on July 13, 2008 in Wushihkeng, Taichung county, central Taiwan. More than 10 individuals of *Paraplotes yuae* **sp. nov.** gathered and fed on leaves of *Dumasia villosa* subsp. *bicolor* (Fabaceae) during the daytime.

Paraplotes cheni Lee, **sp. nov.**

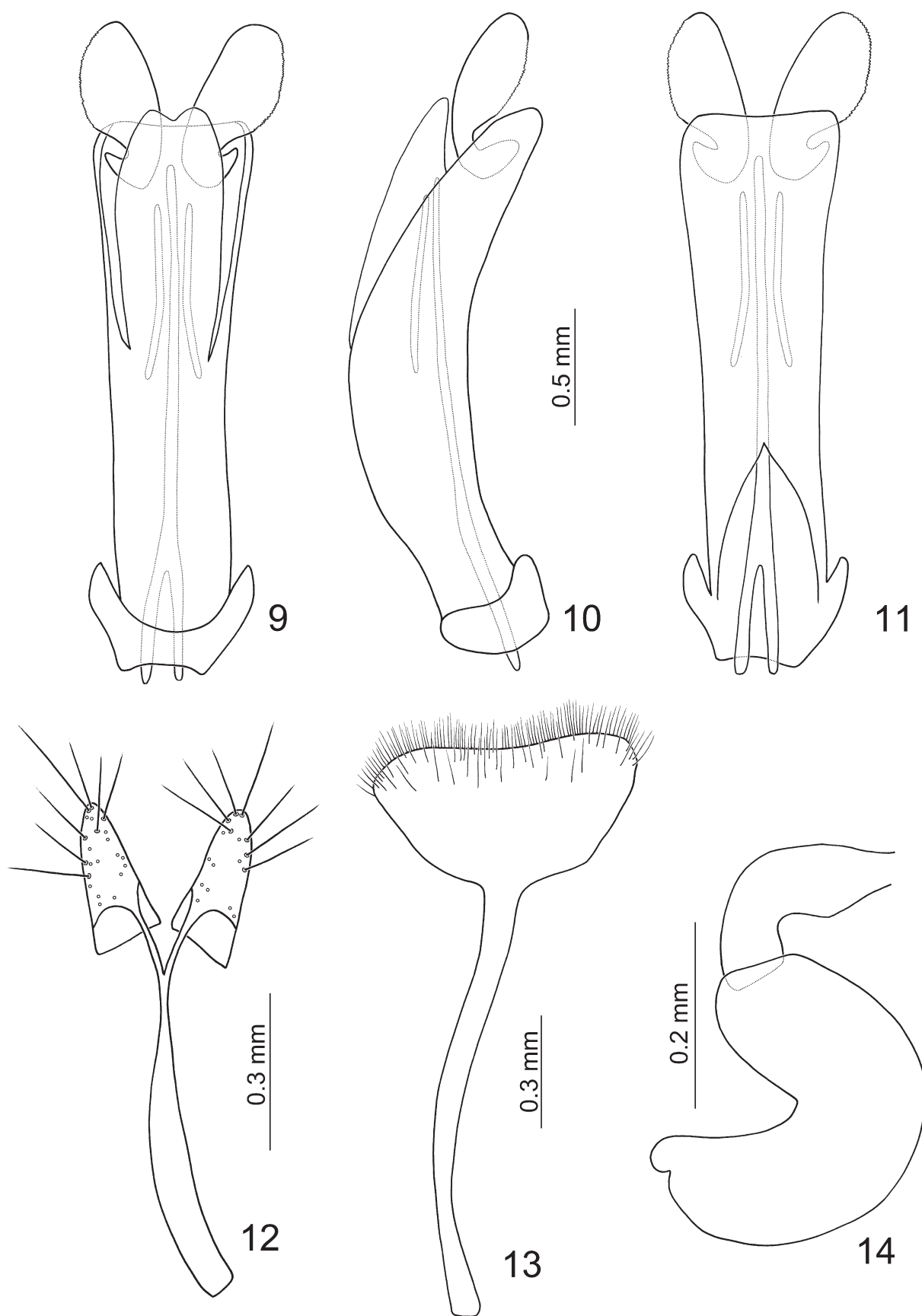
(Figs 9–14, 82)

Type locality. Taiwan: Pingtung county, Tahanshan (大漢山), 22°24'N, 120°45'E, 1400 m.

Type material (n= 13). Holotype ♂ (TARI): **Pingtung:** Tahanshan (大漢山), 29.VI.2013, leg. B.-X. Guo. Paratypes: 3♂♂, 2♀♀, same data as holotype (TARI); 2♂♂, 1♀, same locality, 11.VII.2013, leg. B.-X. Guo (TARI); 2♂♂, 1♀, same locality, 12.VII.2013, leg. Y.-T. Chung (TARI); 1♂, same locality, 14.VIII.2011, leg. Y.-T. Wang (TARI).



FIGURES 1–8. Ecological photography. 1. Habitat for *Paraplotes tatakaensis*, with host plants growing along road; 2. Host plant—*Lecanthus peduncularis* ; 3. An adult *Paraplotes taiwana* feeding on the leaves of *Pilea rotundinucula*; 4. A male of *Paraplotes tahsiangi* attempting to mate with female; 5. Eggs were deposited between roots of host plants; 6. Close up of single egg; 7. Larvae of *Paraplotes jengi* feeding on young shoot; 8. Mature larvae of *Paraplotes jengi*.



FIGURES 9–14. Diagnostic characters of *Paraplotes cheni* Lee, **sp. nov.** 9. Aedeagus, dorsal view; 10. Aedeagus, lateral view; 11. Aedeagus, ventral view; 12. Gonocoxae; 13. Ventrite VIII; 14. Spermatheca.

Description. Male: Length 5.5–5.6 mm, width 3.1–3.2 mm. Dark brown or blackish brown; elytron bluish- or purplish- metallic. Antenna relatively long and slender, about 0.9X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.2 : 1.2 : 1.0 : 1.1 : 1.1 : 1.1 : 1.0 : 1.5. Pronotum strongly transverse, 2.9X wider than long, anterior margin moderately concave; sides anteriorly widened. Elytra long, about 1.5X longer than wide. Aedeagus (Figs 9–11) slender, about 4.6X longer than wide, sides apically widened, apex truncate; in lateral view moderately curved, apex wide; tectum membranous; apico-lateral sclerites large and elongate; lateral spiculae one-paired; median spicula long, about 0.9X as long as aedeagus.

Female: Length 5.9–6.0 mm, width 3.6–3.7 mm. Similar to males, elytra relatively wider than males, about 1.2X longer than wide. Hind wings (Fig. 82) moderately reduced, about 0.28–0.31X as long as those of males, apically reduced. Gonocoxae (Fig. 12) connected with one slender sclerite, longitudinal, widened at basal 1/3; connection between gonocoxa and sclerite extremely slender. Ventricle VIII (Fig. 13) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 14) as wide as pump; pump strongly curved, apex narrowly rounded; spermathecal duct short, slender, shallowly projecting into receptaculum.

Differential diagnosis. *Paraplotes cheni* is similar to *P. jengi* with the truncate apex of the slender median lobe (Figs 9–11, 15–17) but it can be distinguished by the much larger apico-lateral sclerites and lacking projection at middle of apical margin of median lobe in *P. cheni* (Figs 9–11).

Distribution. Only known from the type locality (Fig. 80). Although *Parapotes taiwana* and *P. cheni* have been collected from the same road to Tahanshan, adults of *P. cheni* were collected only from one locality above 1400 m and those of *P. taiwana* collected from localities lower than 1000 m.

Etymology. Named after Mr. Chang Chin Chen for supporting the TCRT in various ways.

Paraplotes jengi Lee, sp. nov.

(Figs 15–20, 83)

Paraplotes taiwana: Kimoto, 1969: 57 (part). (misidentification)

Type locality. Taiwan: Nantou county, Hsitou (溪頭), 23°41'N, 120°48'E, 1600 m.

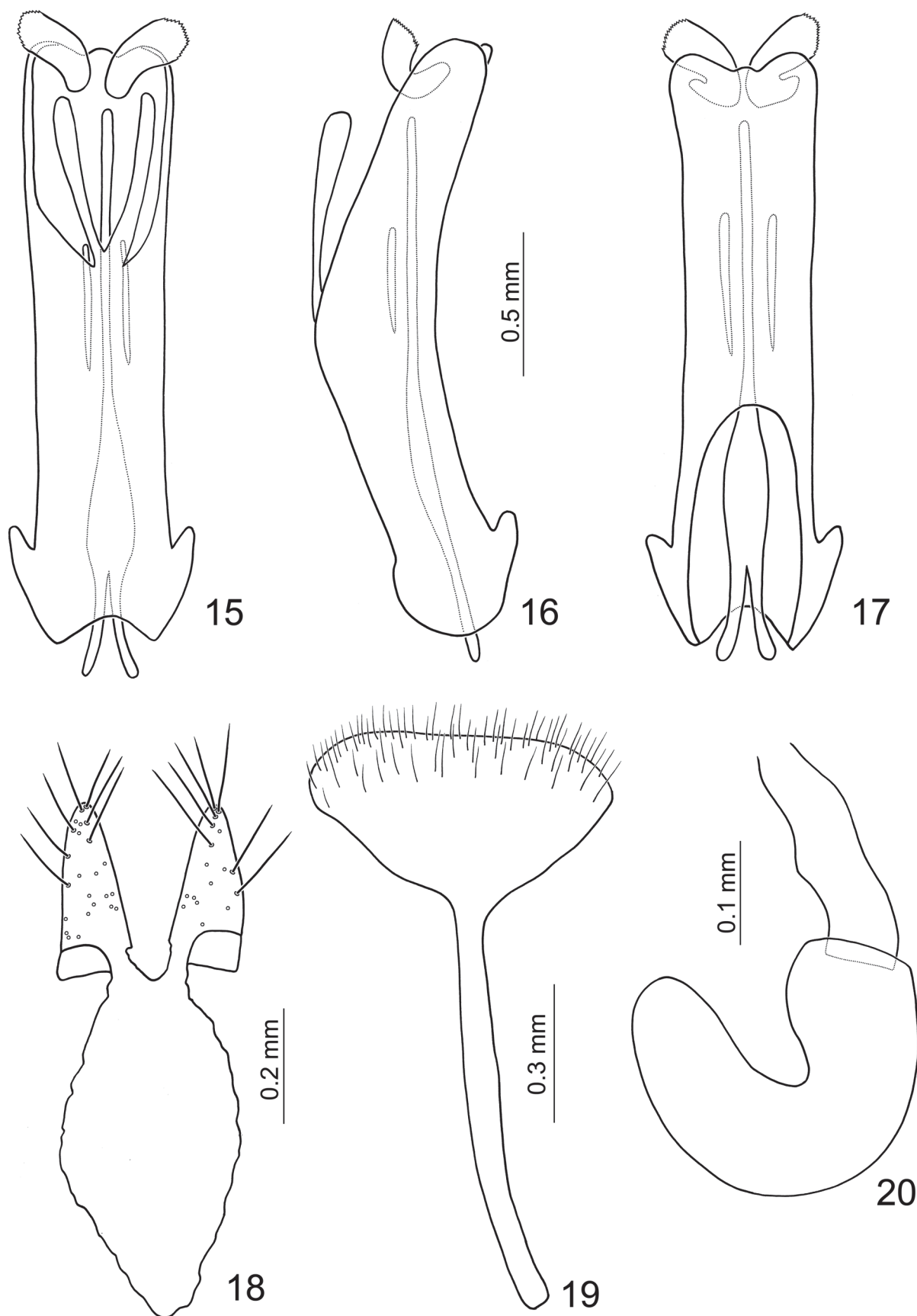
Type material (n= 54). Holotype ♂: **Nantou:** Hsitou (溪頭), 14.VI.2011, leg. C.-F. Lee“ (TARI). Paratypes: 9♂♂, 10♀♀ (TARI), same data as holotype; 1♂, same locality, 6.V.2009, leg. C.-F. Lee (TARI); 1♂, same locality, 7.III.2010, leg. Y.-T. Wang; 9♂♂, 7♀♀, same locality, 9.VIII.2011, leg. C.-F. Lee (TARI); 5♂♂, 1♀, same locality, 9.VIII.2011, leg. M.-H. Tsou (TARI); **Chiayi:** 4♂♂, 3♀♀, Alishan (阿里山), 12.VI.2014, leg. B.-X. Guo (TARI); 1♂, Shihmientung (石面桶), 18.II.2012, leg. M.-L. Jeng (TARI); 2♂♂, Tabu (大埔), 12–22.III.2011, leg. M.-L. Jeng (TARI).

Description. Male: Length 4.4–4.8 mm, width 2.5–2.6mm. Yellowish-brown or dark yellowish-brown; central part of pronotum, last four antennomeres, coxa, base of femur, and tarsi darkened; meso- and metathoracic ventrites blackish brown; elytron bluish- or purplish- metallic. Antenna relatively short, about 0.7X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.1 : 1.1 : 0.9 : 1.0 : 1.1 : 1.0 : 1.0 : 1.0. Pronotum strongly transverse, 2.4X wider than long, anterior margin slightly concave, sides parallel. Elytra long, about 1.5X longer than wide. Aedeagus (Figs 15–17) slender, 4.6X longer than wide, sides parallel, apex truncate, but slightly convex near middle, in lateral view moderately curved, apex wide; tectum sclerotized; apico-lateral sclerites small; lateral spiculae one-paired; median spicula extremely long, about 0.9X as long as aedeagus.

Female: Length 4.1–4.5 mm, width 2.7–2.8 mm. Similar to males, but pronotum anteriorly widened; elytra relatively wider than males, about 1.2–1.3X longer than wide. Hind wings (Fig. 83) extremely reduced, about 0.18–0.20X as long as those of males, lateral margin moderately concave near base. Gonocoxae (Fig. 18) connected with a wide but longitudinal, irregularly-margined sclerite, connection between gonocoxae and sclerite slender. Ventricle VIII (Fig. 19) extremely and apically widened, surface with less dense setae along apex, apical margin truncate without setae, spiculum slender. Spermathecal receptaculum (Fig. 20) as wide as pump; pump strongly curved, apex widely rounded; spermathecal duct short, stout, shallowly projecting into receptaculum.

Color variation. Few males with head and pronotum blackish brown or black, legs dark brown.

Differential diagnosis. *Paraplotes jengi* is similar to *P. yaoi* with the apex of aedeagus truncate and slightly concave near middle (Figs. 15–17, 67–69); but *P. jengi* **sp. nov.** has a more slender aedeagus, smaller apico-lateral sclerites, and one-paired lateral spiculae (Figs. 15–17).



FIGURES 15–20. Diagnostic characters of *Paraplores jengi* Lee, **sp. nov.** 15. Aedeagus, dorsal view; 16. Aedeagus, lateral view; 17. Aedeagus, ventral view; 18. Gonocoxae; 19. Ventrite VIII; 20. Spermatheca.

Distribution. Widespread to Nontou and Chiayi counties (Fig. 79).

Etymology. Dedicated to Dr. Ming-Luen Jeng (NMNS) for collecting part of the type series.

Notes. Specimens collected from Fenchihu (奮起湖) and Alishan (阿里山) (Kimoto 1969) should belong to this species based on the locality (all in Chiayi county).

***Paraplotes meihuai* Lee, sp. nov.**

(Figs 21–32, 84)

Type locality. Taitung county, Motien (摩天), 23°12'N, 121°01'E, 1700 m.

Type material (n= 48). Holotype ♂ (TARI): **Taitung:** Motien (摩天), 20.VI.2011, leg. C.-F. Lee". Paratypes: 10♂♂, 7♀♀, same data as holotype; 1♀, same locality, 24.VI.2010, leg. M.-H. Tsou (TARI); 3♂♂, 2♀♀, Liyuan (栗園), 23.VI.2010, leg. M.-H. Tsou (TARI); 11♂♂, 13♀♀, same locality, 24.VII.2013, leg. C.-F. Lee (TARI).

Description. Male: Length 4.5–4.8 mm, width 2.3–2.5 mm. Dark brown or blackish brown, thoracic and abdominal ventrites black; elytra dark purplish metallic (Figs 21–23). Antenna relatively long, about 0.9X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.1 : 1.3 : 1.3 : 1.3 : 1.5 : 1.3 : 1.3 : 2.3. Pronotum strongly transverse, 2.6–2.7X wider than long, anterior margin slightly concave, lateral margins slightly rounded. Elytra long, about 1.5X longer than wide; disc with coarse punctures. Aedeagus (Figs 27–29) slender, 4.7X longer than wide, sides parallel, apex rounded but slightly asymmetric; in lateral view moderately curved, apically tapering; tectum sclerotized; apico-lateral sclerites small; lateral spiculae two-paired; median spicula short about 0.7X as long as aedeagus.

Female: Length 4.6–5.0 mm, width 2.7 mm. Similar to males; elytra relatively wider than males, about 1.3X longer than wide (Figs 24–26). Hind wings (Fig. 84) moderately reduced, about 0.25–0.28X as long as those of males, lateral margin slightly concave near base or middle. Gonocoxae (Fig. 30) connected with an slender sclerite, abruptly widened at basal 1/3, basal margin truncate; connection between gonocoxae and sclerite extremely slender. Ventrite VIII (Fig. 31) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 32) extremely wide, as wide as pump; pump strongly curved, apically narrowed, apex narrowly rounded; spermathecal duct short, stout, shallowly projecting into receptaculum.

Differential diagnosis. *Paraplotes meihuai* is characterized by its asymmetric and rounded apex of aedeagus and much longer antenna (Figs 21–23).

Distribution. Type specimens were collected on the road from Motien (摩天) to Liyuan (栗園) (Fig. 80) where adults of *Paraplotes taiwana* were also collected (Fig. 79).

Etymology. Dedicated to Mr. Mei-Hua Tsou for collecting type specimens.

***Paraplotes tahsiangi* Lee, sp. nov.**

(Figs 33–38, 85)

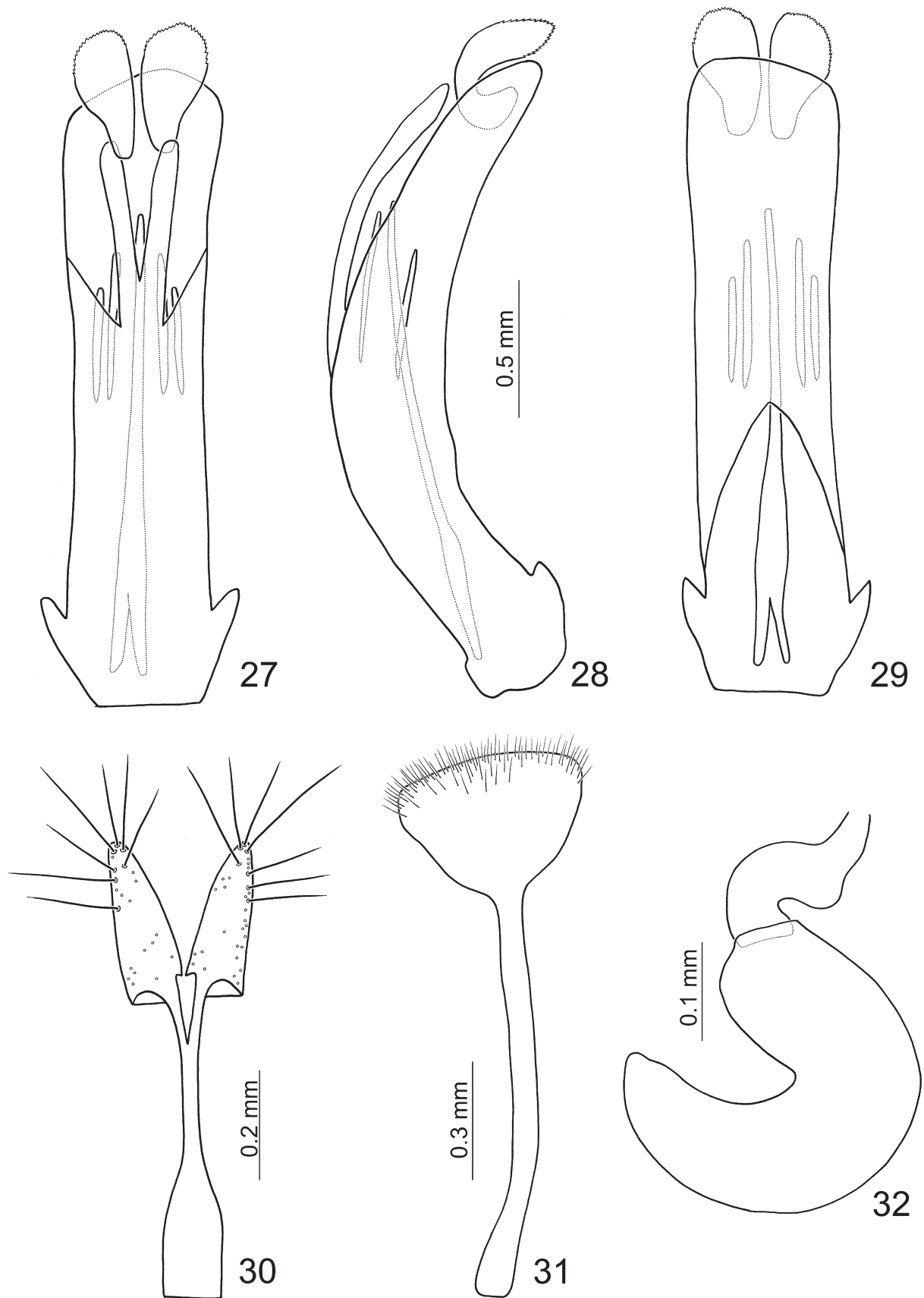
Type locality. Nontou county, Meifeng (梅峰), 24°105'N, 121°10'E, 2100 m.

Type material (n= 59). Holotype ♂ (TARI): **Nantou:** Meifeng (梅峰), 30.V.2011, leg. M.-H. Tsou". Paratypes: 29♂♂, 18♀♀ (TARI), same data as holotype; 2♂♂, same locality, 11.VI. –8.VII.2003, leg. C. S. Lin & W. T. Yang (NMNS); 2♂♂, same locality, 5.V. –11.VI.2003, leg. C. S. Lin & W. T. Yang (NMNS); 2♂♂, same locality, 17.VI.2010, leg. C.-F. Lee (TARI); 3♂♂, same locality, 19.VI.2010, leg. C.-F. Lee (TARI); 3♂♂, same locality, 12.VI.2014, leg. C.-F. Lee (TARI); 2♂♂, Tsuifeng (翠峰), 2300m, 25–27.VI.1981, leg. K. S. Lin & W. S. Tang (TARI).

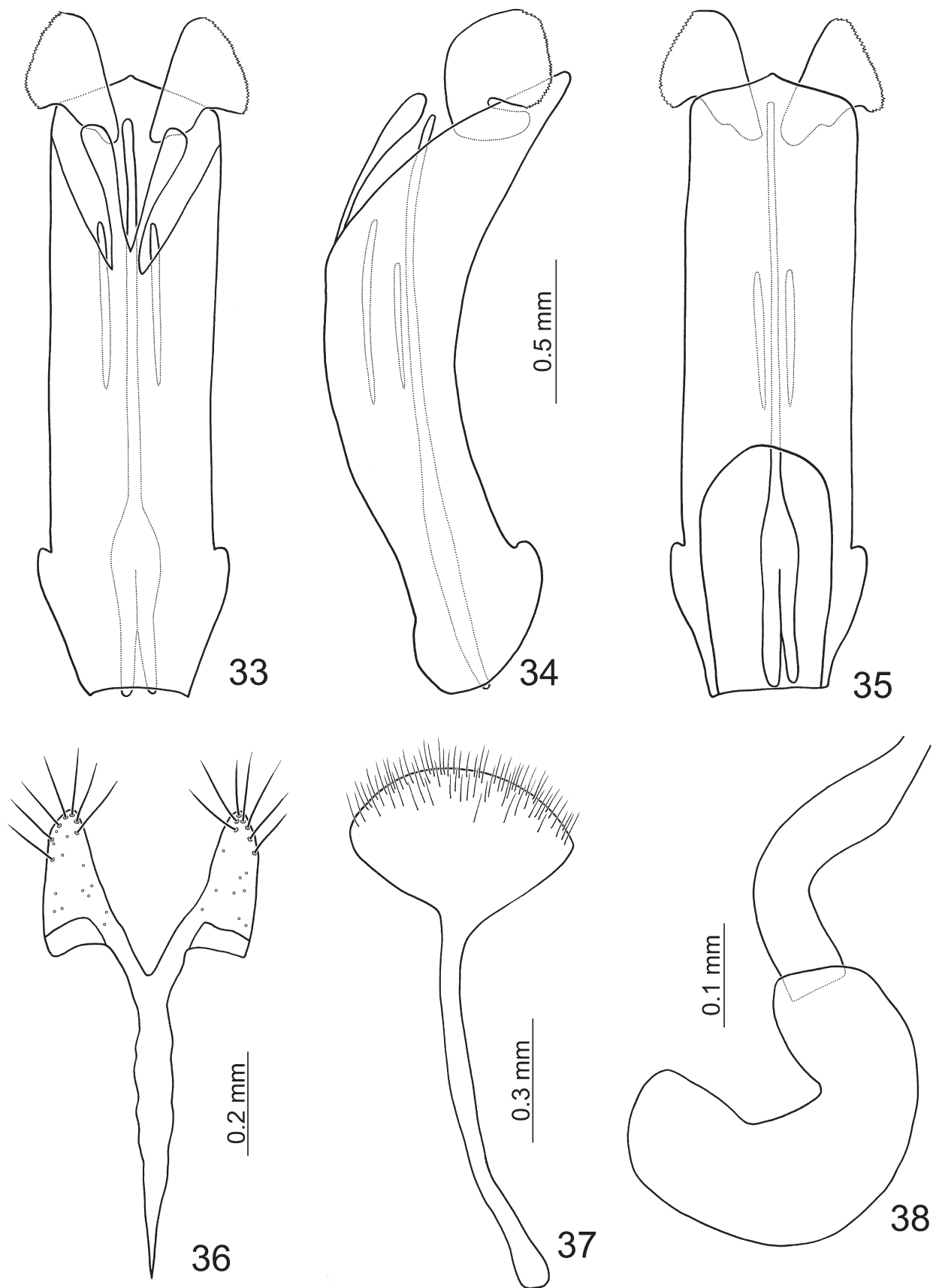
Description. Male: Length 4.7–5.1 mm, width 2.6–2.8 mm. Black but antennae and legs dark brown or blackish brown; elytra dark bluish metallic. Antenna relatively long, about 0.8X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.0 : 1.3 : 1.2 : 1.6. Pronotum strongly transverse, about 2.3X wider than long, anterior margin slightly concave, lateral margins rounded. Elytra long, about 1.5X longer than wide. Aedeagus (Figs 33–35) wide, about 3.8X longer than wide, parallel, abruptly narrowed near apex, apex pointed; in lateral view strongly curved, extremely narrowed toward apex, apex narrowly rounded; tectum sclerotized; apico-lateral sclerites large; lateral speculae two-paired; median specula long, about 0.95X as long as aedeagus.



FIGURES 21–26. Habitus of *Paraplotes meihuai* Lee, **sp. nov.** 21. Male, dorsal view; 22. Male, ventral view; 23. Male, lateral view; 24. Female, dorsal view; 25. Female, ventral view; 26. Female, lateral view.



FIGURES 27–32. Diagnostic characters of *Paraplotes meihuai* Lee, **sp. nov.** 27. Aedeagus, dorsal view; 28. Aedeagus, lateral view; 29. Aedeagus, ventral view; 30. Gonocoxae; 31. Ventrite VIII; 32. Spermatheca.



FIGURES 33–38. Diagnostic characters of *Paraplotes tahsiangi* Lee, **sp. nov.** 33. Aedeagus, dorsal view; 34. Aedeagus, lateral view; 35. Aedeagus, ventral view; 36. Gonocoxae; 37. Ventrite VIII; 38. Spermatheca.

Female: Length 4.5–5.0 mm, width 3.1–3.2 mm. Similar to males but elytra much wider, about 1.2–1.3X longer than wide. Hind wings (Fig. 85) reduced in various degrees, from moderately (0.28X as long as those of males) (Fig. 85a) to extremely (0.16 as long as those of males) (Fig. 85c). Gonocoxae (Fig. 36) connected with a longitudinal sclerite, apically pointed, irregularly margined; connection between gonocoxae and sclerite slender. Ventricle VIII (Fig. 37) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 38) narrower than pump; pump strongly curved, apex narrowly rounded; spermathecal duct short, slender, shallowly projecting into receptaculum.

Differential diagnosis. *Paraplotes tahsiangi* sp. nov. is similar to *P. yaoi* with the wide aedeagus (<4.0X longer than wide) and large apico-lateral sclerites (Figs 33–35, 67–69), but *P. tahsiangi* has the apex of the aedeagus pointed (Figs 33–35) (subtruncate apex in *P. yaoi*).

Distribution. Type specimens were collected on the road from Meifeng (梅峰) to Tsuifeng (翠峰) (Fig. 80).

Etymology. Dedicated to Mr. Ta-Hsiang Lee for assisting in collecting.

Paraplotes taiwana Chûjô, 1963

(Figs 39–50, 81, 86)

Paraplotes taiwana Chûjô, 1963: 25.

Type locality. Hualien county, Juisui (瑞穗), 23°31'N, 121°24'E, 300 m.

Type material (n= 1). Chûjô (1963) described this species based on a single specimen collected from Juisui by Baba, but the depository was not mentioned. Much effort was expended to locate the type (such as Nara Women's College, Nara Pref., Shiga Lake-Biwa Museum, Shiga Pref. and Tainai Insect House, Niigata Pref. where some of Baba's collections were preserved) but these efforts failed. Most Chûjô types were deposited at Kyushu University, but this type was not among them. Recently, late Dr. Satô donated much of his collection to the NMNS including some Chûjô specimens. One specimen included the same data as the holotype. Thus, this specimen is assumed to be the holotype (♂), labeled: “Juisui (Naka spa) E. FORMOSA 28.XI.1962 Coll. K. BABA / NMNS ENT 5503-8816”.

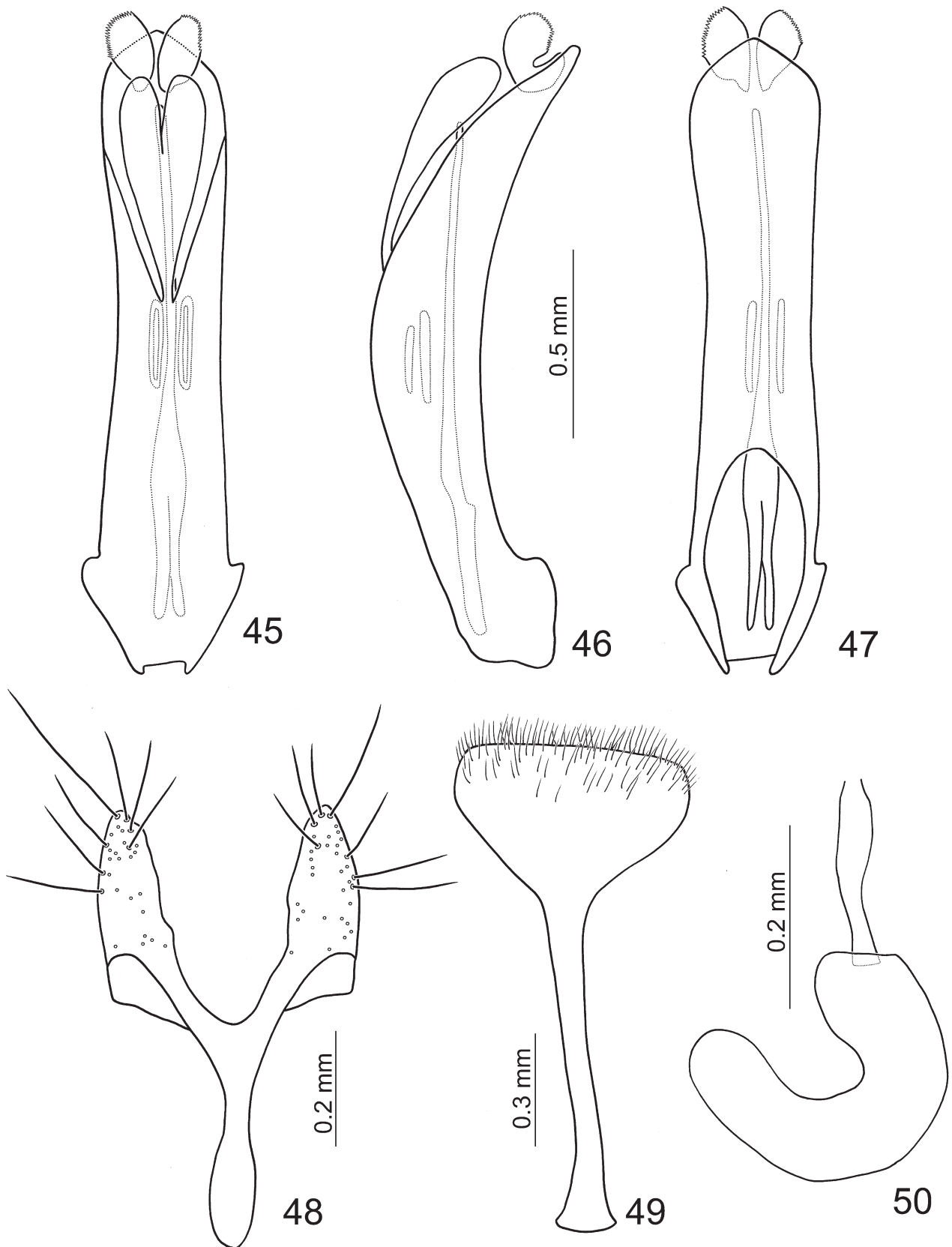
Additional specimens examined (n= 190). **Hualien:** 1♂, Fuyuan, 27.V.1997, leg. C. W. & L. B. O'Brien (NMNS), 1♂, same but with “28.V.1997” (NMNS); **Taitung:** 1♂, Guanshan, 31.X.2009, leg. P.-F. Wang (TARI); 6♂♂, 7♀♀, Liyuan, 24.VII.2013, leg. C.-F. Lee (TARI); 28♂♂, 17♀♀, Motien, 23.V.2011, leg. C.-F. Lee; 1♂, Shinkangshan, 24.III. –19.V.2009, leg. W. T. Yang & K. W. Huang (NMNS); 2♂♂, same but with “19.V. –25.VI.2009” (NMNS); 1♂, same but with “25.VI. –26.VIII.2009” (NMNS); 8♂♂, Shouka, 18.V. –26.VI.2009, leg. W. T. Yang & K. W. Huang (NMNS); 2♀♀, Taimali, 15.I.2009, leg. C.-F. Lee (TARI); 23♂♂, 2♀♀, Tulanshan, Sampling plots # I, 25.VI. –26.VIII.2009, leg. W. T. Yang & K. W. Huang (NMNS); 7♂♂, same but with “26.VIII. –22.IX.2009” (NMNS); 2♂♂, same but with “22.IX. –20.X.2009” (NMNS); 1♂, 2♀♀, same but with “20.X. –8.XII.2009” (NMNS); 1♂, same but with “27.IV. –18.V.2010” (NMNS); 4♂♂, 1♀, same but with “14.IX.–23.XI.2010” (NMNS); 2♂♂, same but with “23.XI. –28.XII.2010” (NMNS); 3♂♂, same but with “1-30.V.2011” (NMNS); 3♂♂, 1♀, same but with “30.V. –26.VII.2011” (NMNS); 3♂♂, same locality and collectors, sampling plots # II, 19.V. –25.VI.2009 (NMNS); 2♂♂, 2♀♀, same but with “26.VIII. –22.IX.2009” (NMNS); 2♂♂, same but with “22.IX. –20.X.2009” (NMNS); 1♂, same but with “20.X. –8.XII.2009” (NMNS); **Pingtung:** 1♀, Jinshuiying, 1.VIII.2011, leg. J.-C. Chen (TARI); 1♀, same locality, 16.VIII.2011, leg. J.-C. Chen (TARI); 2♀♀, same locality, 12.IV.2012, leg. C.-F. Lee (TARI); 3♂♂, Lilungshan, 2.III.2012, leg. J.-C. Chen (TARI); 1♂, same locality, 13.III.2012, leg. J.-C. Chen (TARI); 1♂, Nanjenshan, 7.V.2010, leg. M.-L. Jeng (TARI); 3♂♂, Peitawushan, 23.VI.2011, leg. J.-C. Chen; 1♂, Shuangliu, 5.II.2008, leg. S.-F. Yu (TARI); 4♂♂, Tahanshan, 18.VII.2007, leg. S.-F. Yu (TARI); 1♂, same locality, 20.VII.2007, leg. M.-H. Tsou (TARI); 1♂, same locality, 14.VII.2011, leg. Y.-T. Wang (TARI); 1♀, same locality, 6.I.2012, leg. Y.-C. Chung (TARI); 1♂, same locality, 31.III.2012, leg. W.-C. Liao (TARI); 2♂♂, 19.VII.2012, leg. C.-F. Lee (TARI); 1♂, same locality, 1.X.2012, leg. J.-C. Chen (TARI); 1♂, 2♀♀, same locality, 14.III.2013, leg. Y.-T. Chung (TARI); 1♂, same locality, 25.III.2013, leg. B.-X. Guo (TARI); 12♂♂, 9♀♀, same locality, 26.III.2013, leg. C.-F. Lee (TARI); 1♂, same locality, 4.IV.2013, leg. J.-C. Chen (TARI); 1♂, same locality, 30.VII.2013, leg. Y.-T. Chung (TARI); 1♂, 6.VIII.2013, leg. Y.-T. Chung (TARI); 1♂, same locality, 29.X.2013, leg. Y.-T. Chung (TARI).



FIGURES 39–44. Habitus of *Paraplotes taiwana* Chûjô. 39. Male, dorsal view; 40. Male, ventral view; 41. Male, lateral view; 42. Female, dorsal view; 43. Female, ventral view; 44. Female, lateral view.

Description. Male: Length 4.1–4.6 mm, width 2.4–2.6 mm. Yellowish-brown or dark yellowish-brown, antenna, coxa, base of femur, and tarsi darkened; meso- and metathoracic ventrites blackish brown; elytra bluish- or purplish- metallic (Figs 39–41). Antenna relatively short, about 0.6X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.1 : 1.0 : 1.0 : 1.0 : 0.9 : 1.1 : 1.3 : 1.4. Pronotum strongly transverse, 2.5–2.7X wider than long, anterior margin moderately concave; sides anteriorly widened. Elytra long, about 1.3–1.4X longer than wide; disc with fine punctures. Aedeagus (Figs 45–47) extremely slender, 5.3X longer than wide, sides

parallel, apex moderately rounded; in lateral view moderately curved, apically tapering; tectum sclerotized; apico-lateral sclerites small; lateral spiculae two-paired; median spicula long, about 0.8X as long as aedeagus.



FIGURES 45–50. Diagnostic characters of *Paraplotes taiwana* Chûjô. 45. Aedeagus, dorsal view; 46. Aedeagus, lateral view; 47. Aedeagus, ventral view; 48. Gonocoxae; 49. Ventrite VIII; 50. Spermatheca.

Female: Length 4.9–5.1 mm, width 2.9–3.5 mm. Similar to males, but abdomen blackish-brown; elytra relatively wider, about 1.1–1.2X longer than wide (Figs 42–44); hind wings reduced strongly or moderately, from 0.21X (in Tahanshan: Fig. 86c), to 0.27 (in Tulanshan: Fig. 86a) as long as those of males, some anally reduced, others apically reduced. Gonocoxae (Fig. 48) connected with one slender sclerite, basally widened, base rounded; connection between gonocoxae and sclerite wide. Ventrite VIII (Fig. 49) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender, basal margin truncate. Spermathecal receptaculum (Fig. 50) a little wider than pump; pump strongly curved, apex widely rounded; spermathecal duct short, slender, shallowly projecting into receptaculum.

Differential diagnosis. *Paraplotes taiwana* is similar to *P. takakaensis* with the slender aedeagus and the rounded apex of aedeagus (Figs 45–47, 51–53) but *P. taiwana* has larger apico-lateral sclerites and two paired lateral spiculae of the aedeagus (Figs 45–47).

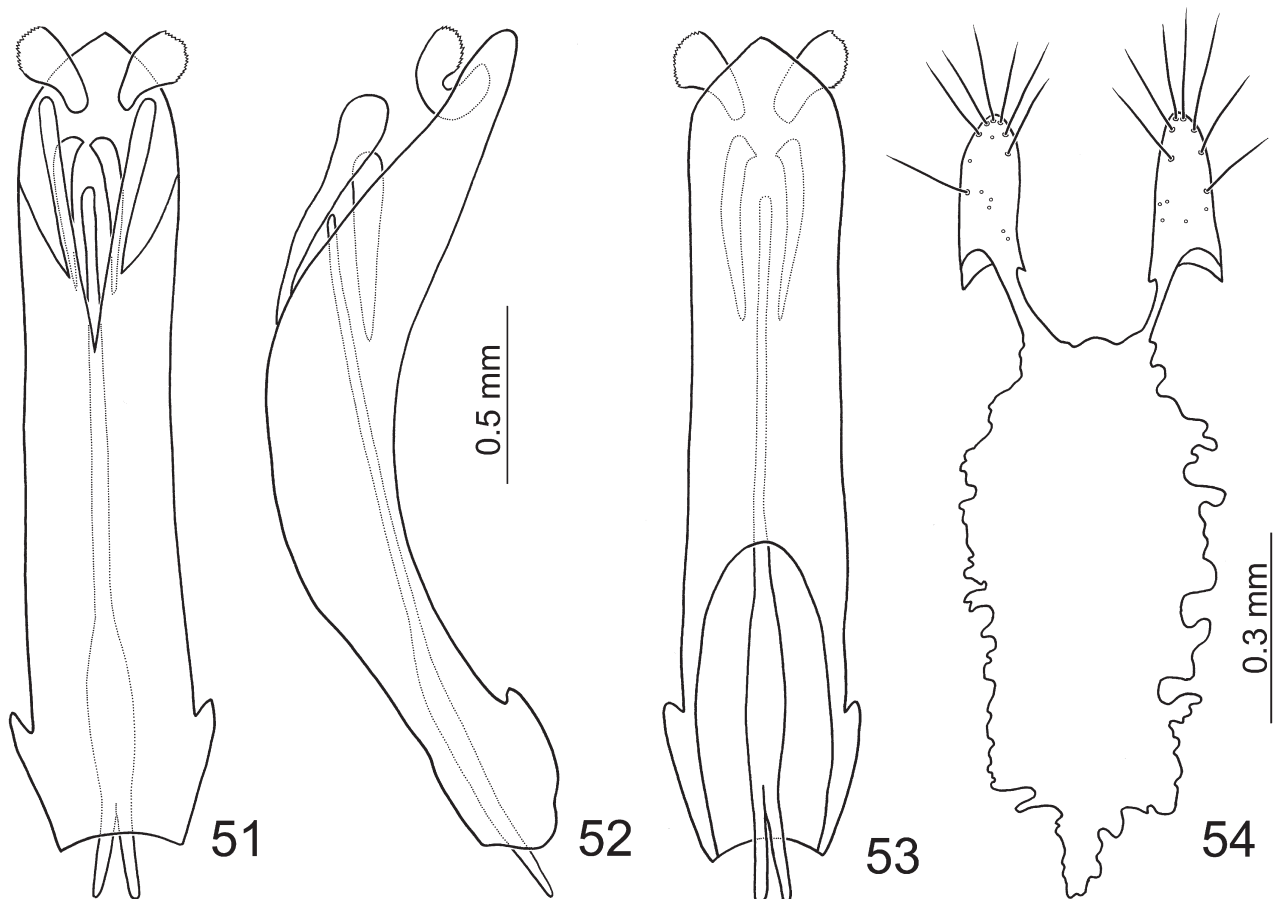
Distribution. Widespread in Southeast Taiwan (Hualien, Taitung, and Pingtung counties) (Fig. 79).

***Paraplotes tatakaensis* Lee, sp. nov.**

(Figs 51–54, 87)

Type locality. Nantou county, Tungfu (同富), near Tatachia (塔塔加), 23°32'N, 120°53'E, 2100 m.

Type material (n= 22). Holotype ♂: Nantou: Tungfu (同富), 8.V.2011, leg. M.-H. Tsou“. Paratypes: 19♂♂, 1♀, same data as holotype, but of which 7♂♂ collected by T.-H. Lee, 7♂♂, 1♀ collected by C.-F. Lee; 1♂, Tatachia (塔塔加), 20.VII.2009, leg. C.-F. Lee.



FIGURES 51–54. Diagnostic characters of *Paraplotes tatakaensis* Lee, **sp. nov.** 51. Aedeagus, dorsal view; 52. Aedeagus, lateral view; 53. Aedeagus, ventral view; 54. Gonocoxae.

Description. Male: Length 4.5–4.7 mm, width 2.3–2.5 mm. Blackish brown or black; sometimes antennae, tibiae, and tarsi dark brown, elytra dark bluish metallic. Antenna relatively short, about 0.7X as long as body; but slender, ratios of length to width of antennomeres III to XI about 1.0 : 1.0 : 0.9 : 0.9 : 0.9 : 1.1 : 1.2 : 0.9 : 1.3. Pronotum strongly transverse, about 2.3–2.5X wider than long, anterior margin slightly concave, lateral margins rounded. Elytra long, about 1.5–1.6X longer than wide. Aedeagus (Figs 51–53) slender, about 5.3X longer than wide, abruptly narrowed near apex, apex pointed; in lateral view strongly curved, gradually narrowed toward apex, apex narrowly rounded; tectum sclerotized; apico-lateral sclerites small; lateral spiculae two-paired; median specula long, about 0.9X as long as aedeagus.

Female: Length 4.6–4.7 mm, width 3.2–3.3 mm. Similar to males but elytra much wider, about 1.2X longer than wide. Hind wings (Fig. 87) extremely reduced, about 0.19X as long as those of males, apically reduced. Gonocoxae (Fig. 54) combined with one wide but longitudinal sclerite, with margin extremely irregular; connection between gonocoxae and sclerite extremely slender. Ventrite VIII and spermatheca lost.

Differential diagnosis. See diagnosis of *Paraplotes taiwana*.

Distribution. Type specimens were collected on the road from Tungfu (同富) to Tatachia (塔塔加) (Fig. 80).

Etymology. Name after one of the type localities.

Paraplotes tsoui Lee, sp. nov.

(Figs 55–60, 88)

Type locality. New Taipei city, Wulai (烏來), 24°51'N, 121°33'E, 300 m.

Type material (n= 22). Holotype ♂: **Taipei:** Wulai (烏來), 22.V.2009, leg. H.-J. Chen" (TARI). Paratypes: 1♂, same locality, 20.VI.2009, leg. C.-F. Lee (TARI); 1♀, Urai (= Wulai), 4.IV.1940, leg. M. Chujo (TARI); 1♂: Fushan (福山), 11.V.2009, leg. H.-J. Chen (TARI); 2♂♂, 1♀: Chihtanshan (直潭山), 12.III.2009, leg. S.-F. Yu (TARI); **Taoyuan:** 3♂♂, 1♀, Lalashan (拉拉山), 13.V.2009, leg. C.-F. Lee (TARI); 1♀, same locality, 18.V.1999, leg. C.W. & L.B. O'Brien (NMNS); 1♀, Tungman (東滿), 2.X.2008, leg. H. Lee (TARI); 1♂, Tungyanshan (東眼山), 12.IV.2007, leg. M.-H. Tsou (TARI); **Ilan:** 1♂, Fushan Chihwuyuan (福山植物園), 20.III, 2009, leg. C.-F. Lee (TARI); 1♂, Mingchi (明池), 16.VIII.2008, leg. M.-H. Tsou (TARI); 1♂, 1♀, Ssuhilintao (四季林道), leg. H.-J. Chen (TARI); 1♂, Taiheizan (= Taipingshan, 太平山), 10.V.1942, leg. A. Tanaka (TARI); 1♂, 1♀, same locality, 30.IV.2009, leg. C.-F. Lee (TARI); **Taichung:** 1♂, Ssuyuan (思源), 9.VI.2009, leg. S.-F. Yu (TARI).

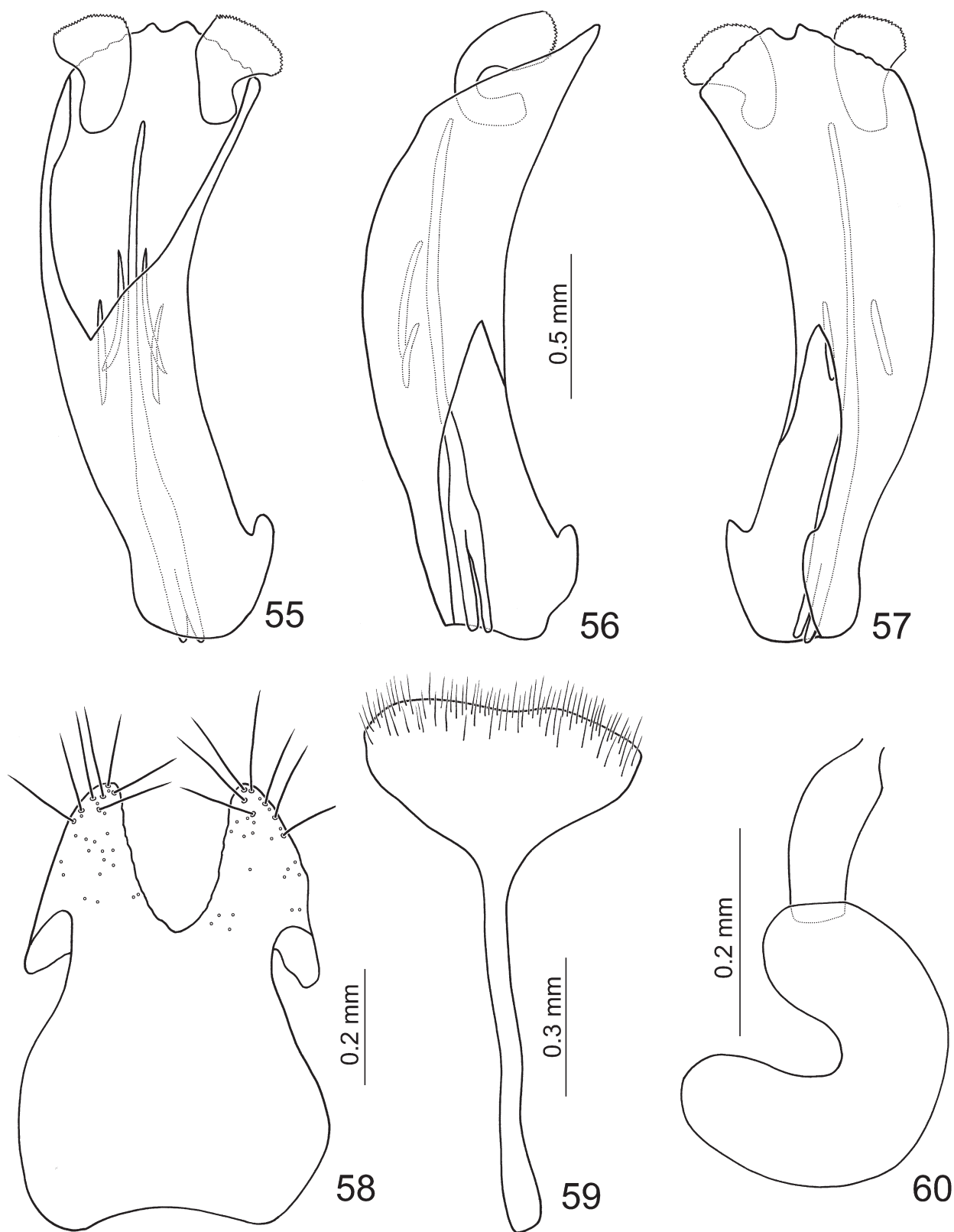
Description. Male: Length 4.6–4.8 mm, width 2.7–2.8 mm. Brown or blackish brown; thoracic and abdominal ventrites blackish brown or black; elytra bluish- or purplish- metallic. Antenna relatively short, about 0.7X as long as body; but slender, ratios of length to width of antennomeres III to XI about 1.0 : 1.0 : 1.0 : 1.0 : 1.1 : 1.0 : 1.0 : 1.1 : 1.5. Pronotum strongly transverse, 2.1X wider than long, anterior margin slightly concave, lateral margin rounded. Elytra long, about 1.4X longer than wide. Aedeagus (Figs 55–57) relative wider about 3.1X longer than wide, twisted at middle, widest near apex, then abruptly narrowed; apex concave at middle of apical margin, apical margin slightly irregular; in lateral view moderately curved, gradually narrowed toward apex; tectum membranous; apico-lateral sclerites large; lateral spiculae two-paired; median specula long, about 0.8X as long as aedeagus.

Female: Length 4.3–4.8 mm, width 2.6–3.0 mm. Similar to males, but elytra relatively wider than males, about 1.3–1.4X longer than wide. Hind wings (Fig. 88) extremely reduced, about 0.14–0.20X as long as those of males, apically reduced. Gonocoxae (Fig. 58) connected with one transverse sclerite, widest near base, basal margin slightly concave; connection between gonocoxae and sclerite extremely wide. Ventrite VIII (Fig. 59) apically and extremely widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 60) as wide as pump; pump strongly curved, apex widely rounded; spermathecal duct short, stout, shallowly projecting into receptaculum.

Differential diagnosis. Similar to *Paraplotes meihuai* (Figs 21–26). *Paraplotes tsoui*, *P. tsuenensis* and *P. yuae* are characterized by their asymmetric and twisted aedeagi (Figs 55–57, 61–63, 73–75). *P. tsoui* and *P. yuae* are separated from *P. tsuenensis* by the irregular and tapering apical margins of aedeagi (Figs 55–57, 73–75). *P. tsoui* differs from *P. yuae* by its wider aedeagus in dorsal and lateral views, and the concave apex (Figs 55–57).

Distribution. Widespread in northern Taiwan (Taipei city, Taoyuan, Ilan, and Taichung counties) (Fig. 79).

Etymology. Dedicated to Mr. Mei-Hua Tsou for collecting a portion of type specimens.



FIGURES 55–60. Diagnostic characters of *Paraplores tsoui* Lee, **sp. nov.** 55. Aedeagus, dorsal view; 56. Aedeagus, lateral view; 57. Aedeagus, ventral view; 58. Gonocoxae; 59. Ventrite VIII; 60. Spermatheca.

***Paraplotes tsuenensis* Lee, sp. nov.**

(Figs 61–66, 89)

Type locality. Hualien county, Tsuen (慈恩), 24°11'N, 121°23'E, 2100 m.

Type material (n= 15). Holotype ♂: Hualien: Tsuen (慈恩), 12.VII.2014, leg. M.-H. Tsou. Paratypes: 8♂♂, 6♀♀, same data as holotype.

Description. Male: Length 4.9–5.0 mm, width 2.4–2.5 mm. Blackish brown; elytra bluish- or purplish-metallic. Antenna relatively long, about 0.8X as long as body; but slender, ratios of length to width of antennomeres III to XI about 1.0 : 1.1 : 1.1 : 1.0 : 1.2 : 1.0 : 1.2 : 1.1 : 1.5. Pronotum strongly transverse, 2.5X wider than long, anterior margin slightly concave, lateral margin rounded. Elytra long, about 1.6X longer than wide. Aedeagus (Figs 61–63) relative wider about 3.3X longer than wide, twisted at middle, widest at apex, then abruptly narrowed, apical margin subtruncate; in lateral view moderately curved, apex subequal to base in width; tectum membranous; apico-lateral sclerites large; lateral spiculae two-paired; median specula long, about 0.8X as long as aedeagus.

Female: Length 4.3–4.6 mm, width 2.6–3.0 mm. Similar to males, but elytra relatively wider than males, about 1.2–1.4X longer than wide. Hind wings (Fig. 89) extremely reduced, about 0.20–0.23X as long as those of males. Gonocoxae (Fig. 64) connected with one longitudinal sclerite, narrowest near base, basal margin slightly concave; connection between gonocoxae and sclerite wide. Ventrite VIII (Fig. 65) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 66) as wide as pump; pump strongly curved, apex widely rounded; spermathecal duct short, stout, shallowly projecting into receptaculum.

Differential diagnosis. See diagnosis of *Paraplotes tsoui*.

Distribution. Only known from the type locality (Fig. 80).

Etymology. Named after the type locality.

***Paraplotes yaoi* Lee, sp. nov.**

(Figs 67–71, 90)

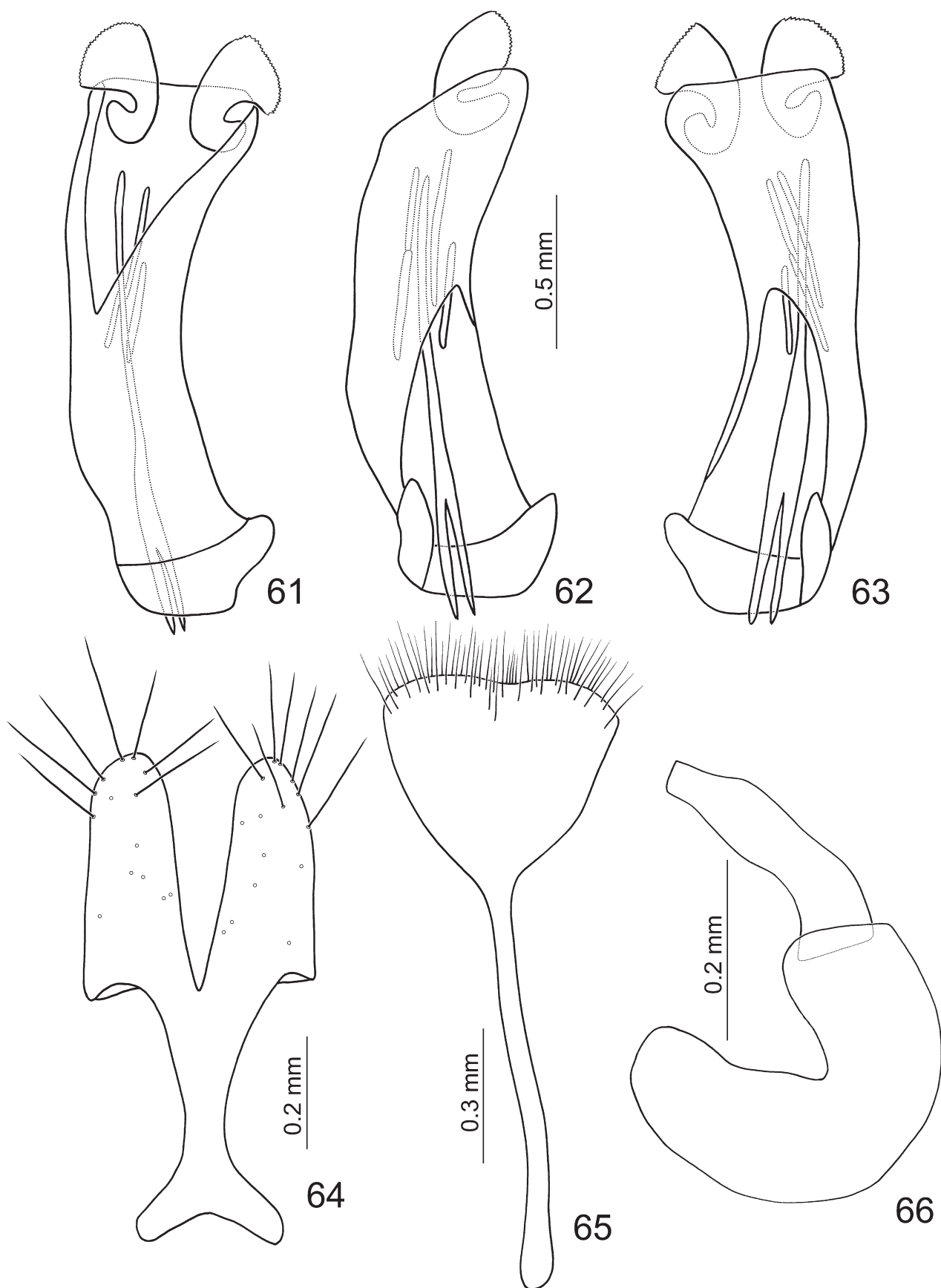
Paraplotes taiwana: Kimoto, 1966: 33; Kimoto, 1991: 16. (misidentification)

Type locality. Kaoshiung county, Tengchih (藤枝), 23°04'N, 120°45'E, 1500 m.

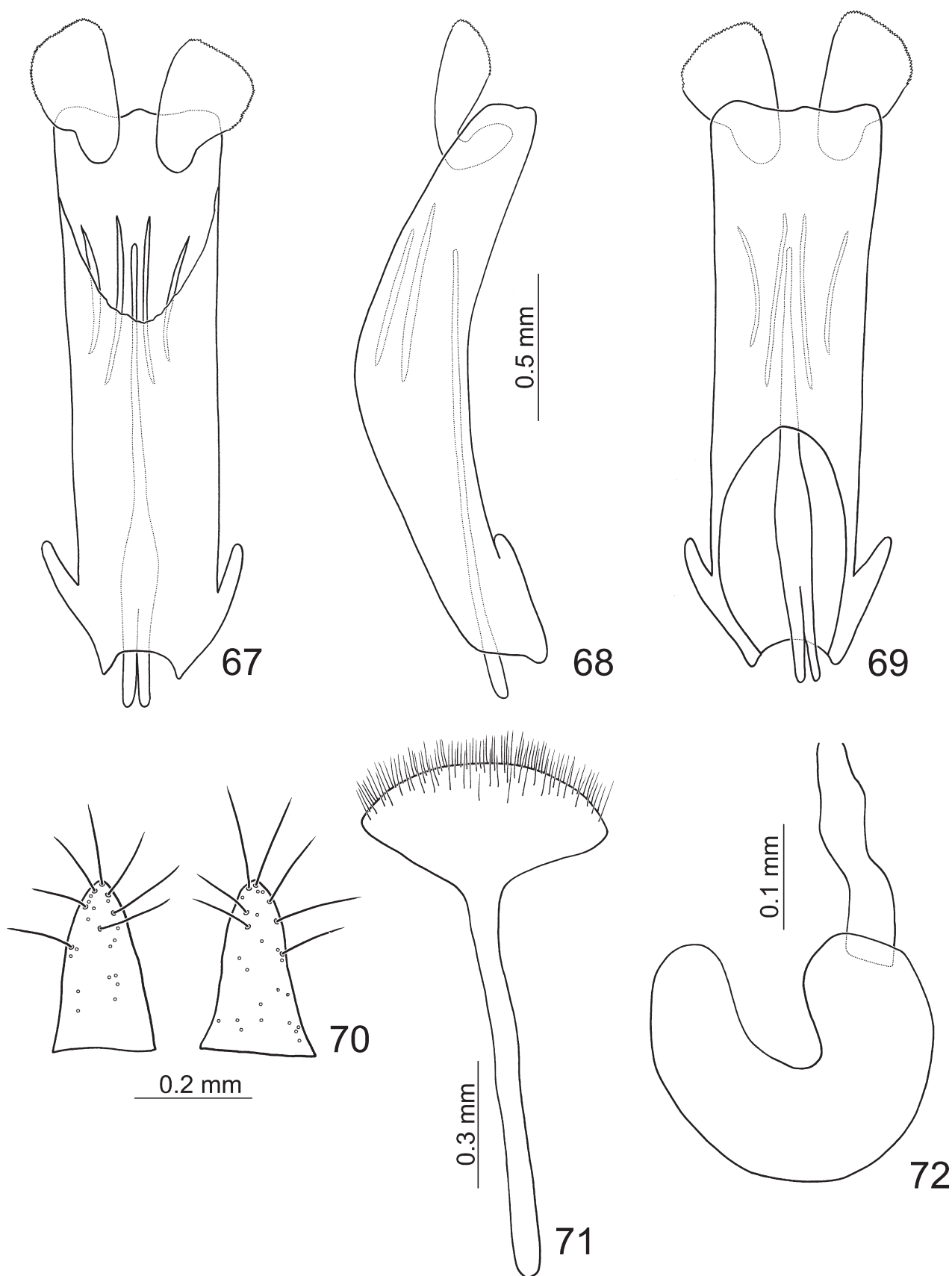
Type material (n= 58). Holotype ♂, **Kaoshiung**, Tengchih (藤枝), 26.V.2009, leg. C.-F. Lee. Paratypes: 2♂♂, 2♀♀, same data as holotype; 1♂, same locality, 2–5.VI.2008, leg. C.-F. Lee (TARI); 1♂, 2♀♀, same locality, 5.II.2009, leg. M.-H. Tsou; 5♂♂, 2♀♀, same locality, 18.IV.2013, leg. B.-X. Guo (TARI); 4♂♂, 1♀, same locality, 18.IV.2013, leg. Y.-T. Chung (TARI); 1♂, same locality, 8.VI.2013, leg. W.-C. Liao (TARI); 2♂♂, 1♀, same locality, 6.VII.2013, leg. W.-C. Liao (TARI); 4♂♂, 5♀♀, 3.VIII.2013, leg. B.-X. Guo (TARI); 1♂, 1♀, same locality, 6.VIII.2013, leg. B.-X. Guo (TARI); 1♂, same locality, 10.VIII.2013, leg. W.-C. Liao (TARI); 1♂, Shanping (扇平), 31.VI.1997, leg. K.-J. Wu (NMNS); 1♂, 2♀♀, Taoyuan (桃源), 1.VII.2009, leg. M.-H. Tsou; 2♀♀, same locality, 1.VII.2009, leg. S.-F. Yu (TARI); 2♂♂, 1♀, Tonalintao (多納林道), 6.VII.2011, leg. M.-H. Tsou (TARI); 1♂, same locality, 3.II.2013, leg. W.-C. Liao (TARI); **Pingtung**: 8♂♂, 3♀♀, Machiatsun (瑪家村), 22.IX. leg. J.-C. Chen (TARI).

Description. Male: Length 4.5–4.8 mm, width 2.2–2.4 mm. Yellowish-brown or dark yellowish-brown, antenna, coxa, base of femur, and tarsi darkened; meso- and metathoracic ventrites, and abdomen blackish brown; elytron bluish- or purplish- metallic. Antenna relatively long and slender, about 0.8X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.1 : 1.0 : 0.9 : 1.1 : 1.0 : 1.1 : 1.1 : 1.5. Pronotum strongly transverse, 2.2–2.5X wider than long, anterior margin moderately concave; sides anteriorly widened. Elytra long, about 1.6X longer than wide. Aedeagus (Figs 67–69) wide, about 3.4X longer than wide, sides parallel, apex truncate, but slightly convex near middle; in lateral view moderately curved, apex wide; tectum membranous; apico-lateral sclerites large; lateral spiculae two-paired; median spicula long, about 0.8X as long as aedeagus.

Female: Length 4.4–4.6 mm, width 2.9–3.1 mm. Similar to males, elytra relatively wider than males, about 1.2X longer than wide. Hind wings extremely reduced or moderately, from 0.22 (in Taoyuan: Figs 90d & e), 0.24X (in Tengchih: Fig. 90b), to 0.31X (in Machiatsun: Fig. 90a) as long as those of males, Gonocoxae (Fig. 70)



FIGURES 61–66. Diagnostic characters of *Paraplotes tsuenensis* Lee, **sp. nov.** 61. Aedeagus, dorsal view; 62. Aedeagus, lateral view; 63. Aedeagus, ventral view; 64. Gonocoxae; 65. Ventrite VIII; 66. Spermatheca.



FIGURES 67–72. Diagnostic characters of *Paraplotes yaoi* Lee, **sp. nov.** 67. Aedeagus, dorsal view; 68. Aedeagus, lateral view; 69. Aedeagus, ventral view; 70. Gonocoxae; 71. Ventrite VIII; 72. Spermatheca.

separated, without sclerites connected. Ventricle VIII (Fig. 71) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 72) as wide as pump; pump strongly curved, apex widely rounded; spermathecal duct short, slender, shallowly projecting into receptaculum.

Differential diagnosis. See diagnosis of *Paraplotes jengi*.

Distribution. Widespread in south Taiwan (Kaohsiung and Pingtung counties) (Fig. 79).

Etymology. Dedicated to Dr. Cheng-Te Yao for assisting in collecting.

Notes. Specimens collected from Hoozan (= Fengshan 鳳山) (Kimoto 1966) and Liu Kui (六龜) (Kimoto 1991) should belong to this species based on the localities (all in Kaoshiung county).

***Paraplotes yuae* Lee, sp. nov.**

(Figs 73–78, 91)

Paraplotes taiwana: Kimoto, 1969: 57 (part). (misidentification)

Type locality. Taichung county, Anmashan (鞍馬山), 24°15'N, 121°00'E, 2200 m.

Type Material (n= 43). Holotype ♂: **Taichung:** Anmashan (鞍馬山), 7.VI.2010, leg. C.-F. Lee". Paratypes: 9♂♂, 4♀♀, same data as holotype; 1♂, Hassenzan (= Pahsienshan, 八仙山), 26.VI.1936, leg. L. Gressitt (BPBM); 1♂, Wushihkeng (烏石坑), 19.III.2008, leg. C.-F. Lee (TARI); 8♂♂, 1♀, same locality, 13.VII.2008, leg. C.-F. Lee; 9♂♂, 6♀♀, same locality, 21.III.2013, leg. C.-F. Lee (TARI); **Hsinchu:** 1♂, Chienshih (尖石), 26.VII.2008, leg. H.-J. Chen; 1♂, Mamei, 4.V.2008, leg. S.-F. Yu; 1♀, Wuchihshan (五指山), 14.V.2008, leg. S.-F. Yu.

Description. Male: Length 4.8–5.0 mm, width 2.3–2.4 mm. Blackish-brown, antenna, antennae, tibiae, and tarsi dark brown; elytron dark bluish-metallic. Antenna relatively short and slender, about 0.7X as long as body; ratios of length to width of antennomeres III to XI about 1.0 : 1.1 : 1.0 : 1.0 : 1.2 : 1.1 : 1.2 : 1.3 : 1.1. Pronotum strongly transverse, 2.2–2.5X wider than long, anterior margin moderately concave; sides anteriorly widened. Elytra relatively shorter, about 1.7X longer than wide. Aedeagus (Figs 73–75) slender, about 3.9X longer than wide, twisted at middle, widest near apex, then abruptly narrowed, apex asymmetric, pointed, apical margin irregular; in lateral view slightly curved, abruptly narrowed near apex; tectum membranous; apico-lateral sclerites large; lateral speculae two-paired; median spicala long, about 0.8X as long as aedeagus.

Female: Length 4.3–4.7 mm, width 2.6–2.9 mm. Similar to males, but elytra wider than males, about 1.3–1.4X longer than wide. Hind wings reduced in various degrees, from slightly (0.38X as long as those of males, collected from Wushihkeng: Fig. 91a), moderately (0.28X as long as those of males, collected from Anmashan: Fig. 91b), to extremely reduced (0.18X as long as those males, collected from Wuchihshan: Fig. 91c). Gonocoxae (Fig. 76) connected with one wide but longitudinal sclerite, with lateral margins irregular; connection between gonocoxae and sclerite wide. Ventricle VIII (Fig. 77) apically widened, surface with dense setae along apex, as well as apical margin, spiculum slender. Spermathecal receptaculum (Fig. 78) as wide as pump; pump strongly curved, apex narrowly rounded; spermathecal duct short, slender, shallowly projecting into receptaculum.

Differential diagnosis. See diagnosis of *Paraplotes tsoui*.

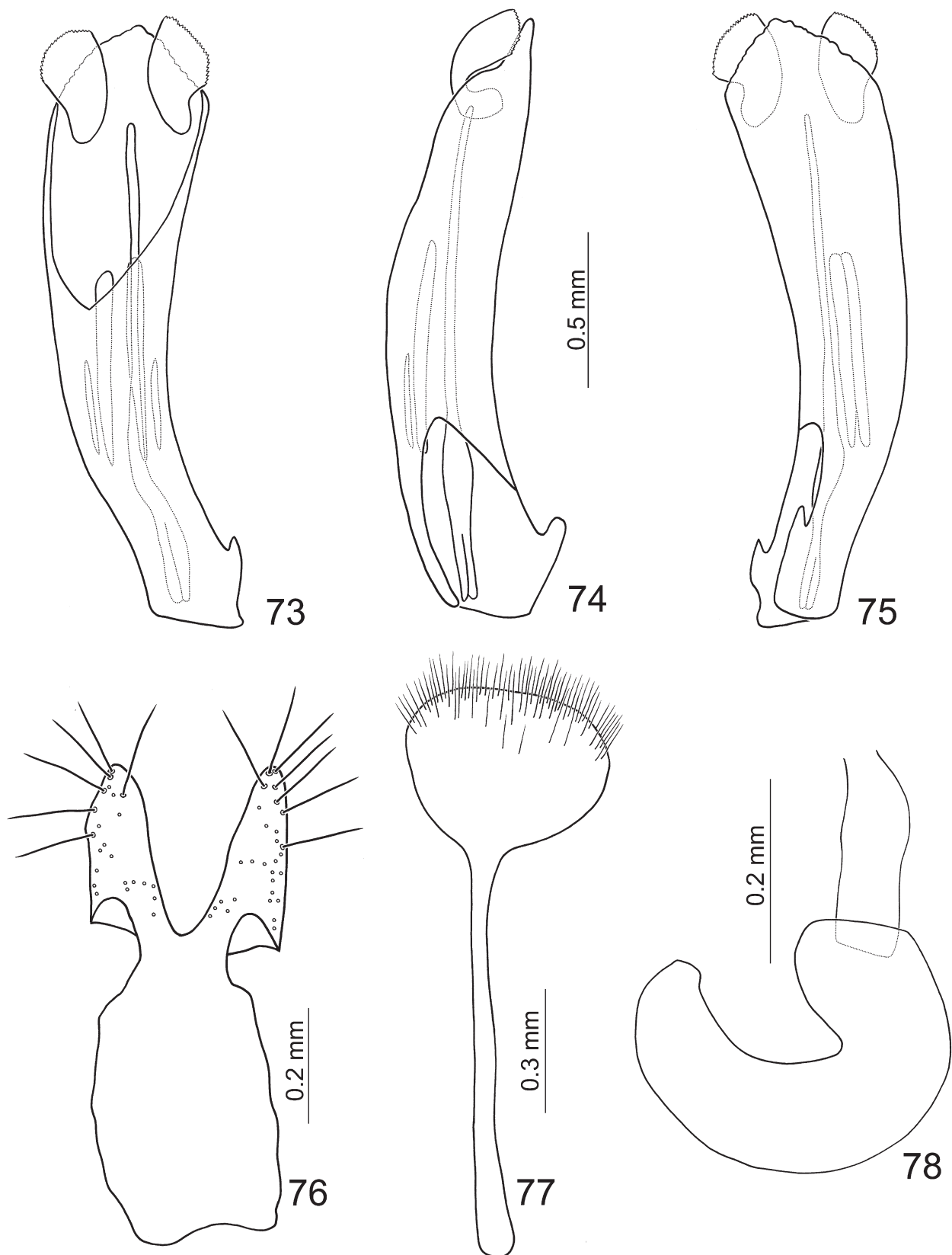
Distribution. Widespread in central Taiwan (Hsinchu and Taichung counties) (Fig. 79).

Etymology. Dedicated to Mrs. Su-Fang Yu for collecting a portion of the type specimens.

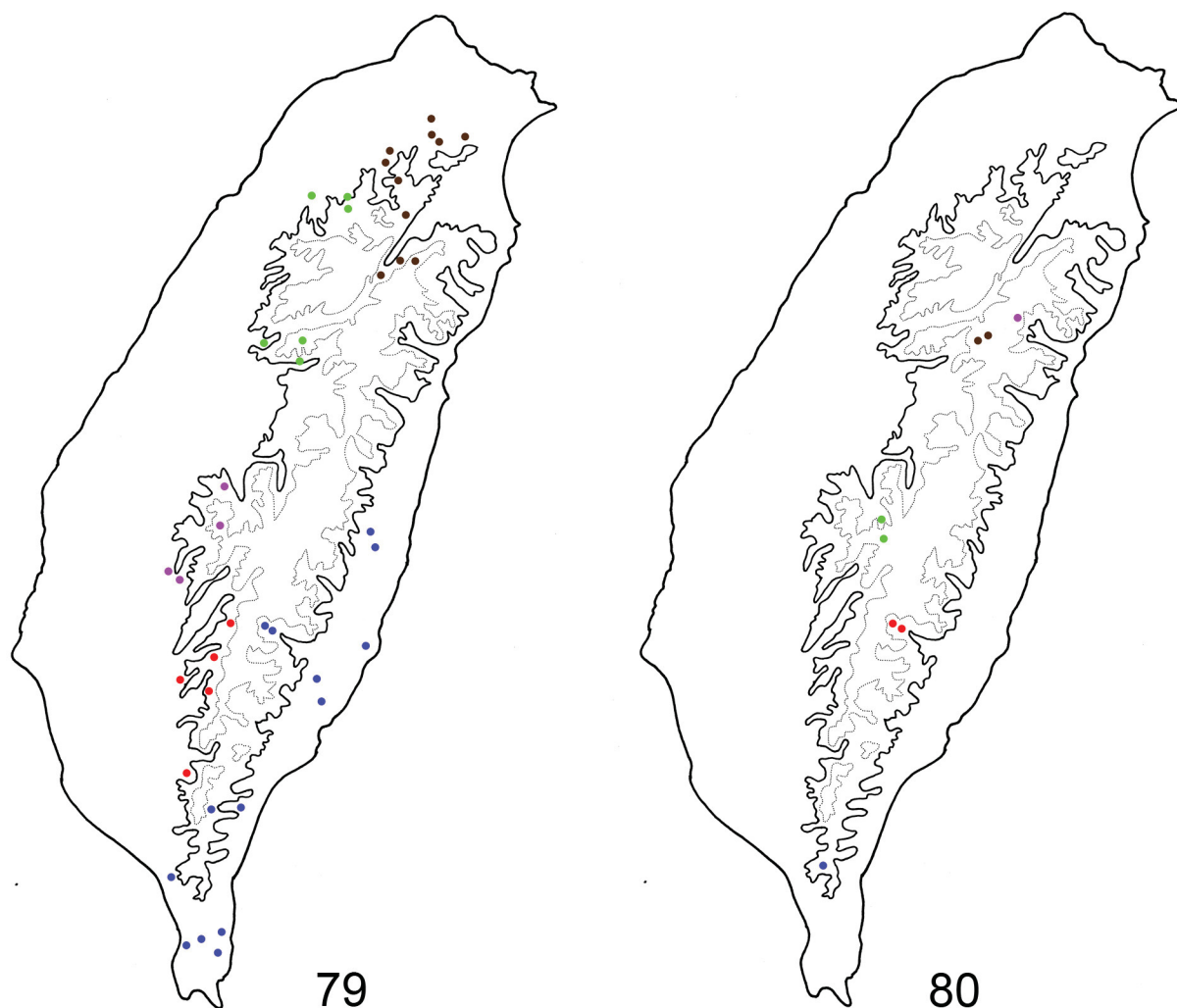
Notes. The specimen collected from Hassenzan (八仙山) (Kimoto 1969) belongs to this species.

Key to the species of *Paraplotes* in Taiwan

Color patterns and sizes of elytra separate the species of *Paraplotes* in Taiwan into two groups: one has wider elytra and yellowish brown coloration (including *P. jengi*, *P. taiwana*, and *P. yaoi*), the other has slender elytra and dark or blackish brown coloration (including *P. cheni*, *P. meihuai*, *P. tahsiangi*, *P. tatakaensis*, *P. tsuenensis*, and *P. yuae*). However, these characters are variable in most species. Thus, this key is solely based on the aedeagus, which possess more reliable diagnostic characters.

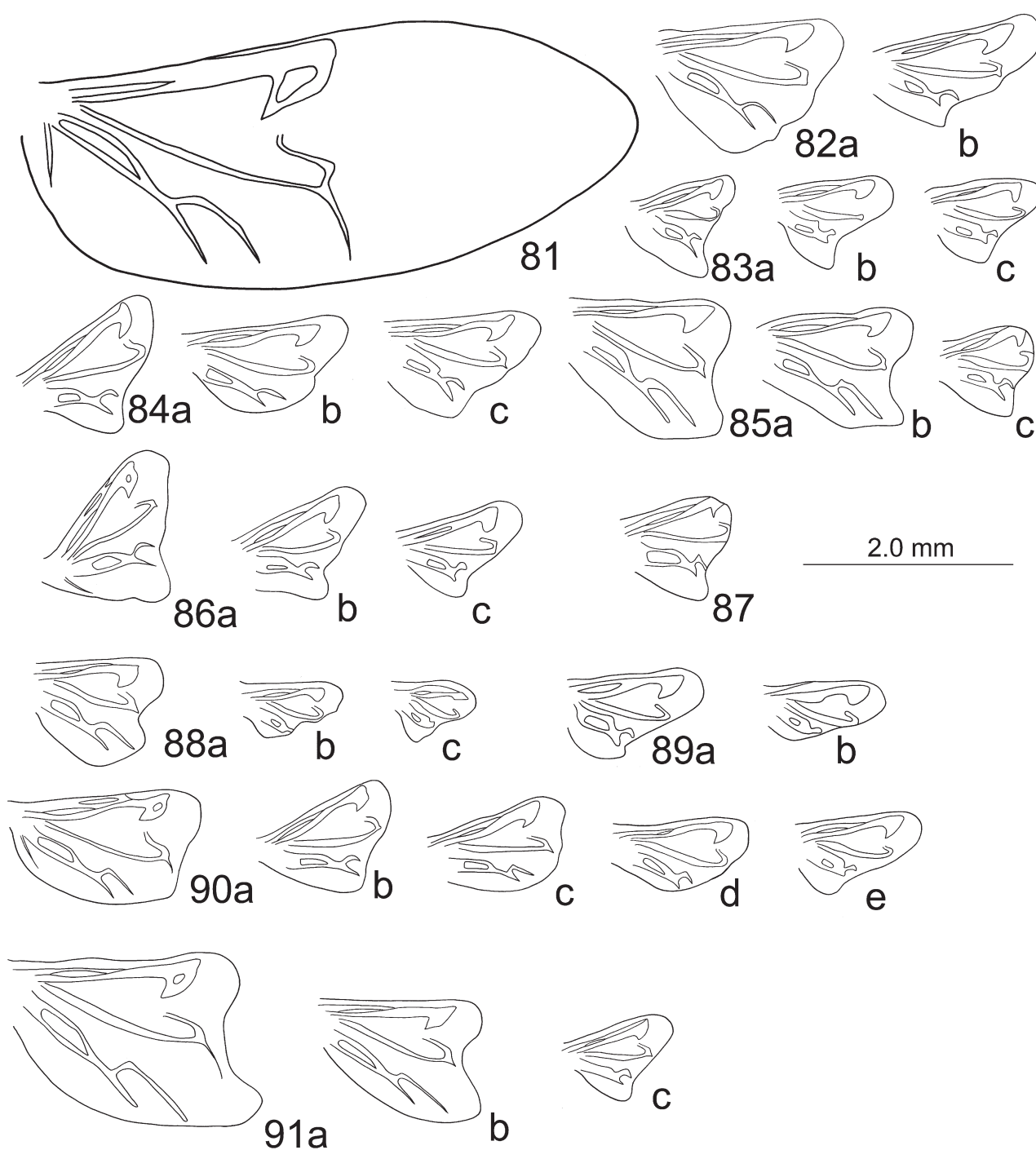


FIGURES 73–78. Diagnostic characters of *Paraplotes yuae* Lee, **sp. nov.** 73. Aedeagus, dorsal view; 74. Aedeagus, lateral view; 75. Aedeagus, ventral view; 76. Gonocoxae; 77. Ventrite VIII; 78. Spermatheca.



FIGURES 79–80. Distribution map of *Paraplotes* species of Taiwan, solid line: 1000 m, broken line: 2000 m. 79. Widespread species, brown dots: *P. tsoui*, green dots: *P. yuae*, pink dots: *P. jengi*, red dots: *P. yaoi*, blue dots: *P. taiwana*; 80. Localized species, brown dots: *P. tahsiangi*, pink dot: *P. tsuenensis*, green dots: *P. tatakaensis*, red dots: *P. meihuai*, blue dot: *P. cheni*.

1. Aedeagus twisted. 2
- Aedeagus normal. 4
2. Apical margin of aedeagus smooth and subtruncate, apex subequal to base in length (Figs 61–63) *P. tsuenensis* **sp. nov.**
- Apical margin of aedeagus irregular and tapering anterior, apex wider than base 3
3. Aedeagus wider (3.1X longer than wide), with apex concave, slightly curved in lateral view, abruptly narrowed near apex (Figs 55–57) *P. tsoui* **sp. nov.**
- Aedeagus narrower (3.9X longer than wide), with apex pointed, strongly curved in lateral view, gradually and apically narrowed (Figs 73–75) *P. yuae* **sp. nov.**
4. Apex of aedeagus asymmetric (Figs 27–29) *P. meihuai* **sp. nov.**
- Apex of aedeagus symmetric 5
5. Apex of aedeagus truncate, or slightly concave, and slightly convex near middle 6
- Apex of aedeagus rounded or pointed. 8
6. Aedeagus wide (<4.0X longer than wide), lateral spiculae two paired (Figs 67–69) *P. yaoi* **sp. nov.**
- Aedeagus slender (>4.0X longer than wide, lateral spiculae one paired 7
7. Apex of aedeagus truncate, without projection at middle of apical margin; apico-lateral sclerites much larger and elongate (Figs 9–11) *P. cheni* **sp. nov.**
- Apex of aedeagus truncate or slightly concave, and convex at middle of apical margin; dorsal-lateral sclerites smaller (Figs 15–17) *P. jengi* **sp. nov.**
8. Aedeagus wide (<4.0X longer than wide), apex pointed (Figs 33–35). *P. tahsiangi*, **sp. nov.**
- Aedeagus slender (>5.0X longer than wide), apex rounded 9
9. Apico-lateral sclerites large, lateral spiculae two paired (Figs 45–47) *P. taiwana* Chûjô
- Apico-lateral sclerites small, lateral spiculae one paired (Figs 51–53). *P. tatakaensis* **sp. nov.**



FIGURES 81–91. Hind wings. 81: male; 82–85: females. 81, *Paraplotes taiwana*, Tulanshan; 82, *P. cheni*, a & b, different individuals from same population; 83, *P. jengi*, a–c, different individuals from same population; 84, *P. meihuai*, a–c, different individuals from same population; 86, *P. taiwana*, a: Tulanshan, b: Motien, c: Tahanshan; 87, *P. tatakaensis*; 88, *P. tsoui*, a: Chihlanshan, b: Lalashan, c: Taipingshan; 89, *P. tsuenensis*, a & b, different individuals from same population; 90, *P. yaoi*, a: Machiatsun, b: Tengchih, c: Tona, d & e: Taoyuan; 91. *P. yuae*, a: Wushihken; b: Anmashan, c: Wuchihshan.



FIGURES 92–97. Wingless galerucines in Taiwan. 92: *Apterogaleruca* sp.; 93: *Hirtigaleruca* sp.; 94: *Shaira* sp.; 95: *Shairella* sp.; 96: *Taiwanolepta* sp.; 97: *Furusawaia* sp.

Discussion

Adults of *Paraplotes* are nocturnal and can be collected using Malaise traps if traps are set around host plants. A number of adults of *P. taiwana* were collected using Malaise traps in Tulanshan (Taitung county) by NMNS. The results indicated that adults appear year round with peak abundance during late June to late August. This species is limited to lowlands not higher than 1500 m. Thus species that inhabit lowlands, including *P. jengi*, *P. tsoui*, *P. yaoi* and *P. yuae*, may have similar bionomics as *P. taiwana*. Other species limited to mountains only appear after May and disappear during October, based on our experiences.

The high diversity of *Paraplotes* in Taiwan is surprising. *All widespread species inhabit lowlands (Fig. 79), as mentioned above.* Others inhabiting middle and high elevations (1500–2500 m) are localized (Fig. 80), including *P. cheni*, *P. meihuai*, *P. tahsiangi*, *P. tsuenensis* and *P. tatakaensis*. Almost all species are allopatric except *P. taiwana*,

which appears to be sympatric with *P. meihuai* in Motien and Liyuan and with *P. cheni* in Tahanshan, respectively. In fact, *Paraplotes taiwana* is not sympatric with *P. cheni* since *P. cheni* is only found above 1400 m while *P. taiwana* is only found below 1000 m in Tahashan mountains. In sympatric situations, *Paraplotes taiwana* can be separated from *P. meihuai* by external morphology. The former has wider elytra and yellowish brown coloration (Figs 39–44) but the latter has slender elytra and dark or blackish brown coloration (Figs 21–26).

Reduction of hind wings in females varies greatly among inter- or infraspecific populations although such variation is much less within the same population. Most females of the same populations, based on proximity of collections, have similar lengths of hind wings. Widths may vary greatly in females of *Paraplotes cheni* (Fig. 82), *P. jengi* (Fig. 83), and *P. meihuai* (Fig. 84). Reduction of hind wings may vary greatly among different populations. For example, the population of *Paraplotes yuae* collected from Wushihkeng (Fig. 91a) has the least reduced hind wings (38%), by the contrast, reduction is extreme in Wuchihshan (18%: Fig. 91c). Such variations may result from the occasional occurrence of diurnal behavior for the population in Wushihkeng. Possibly, nocturnal behavior may promote reduction of hind wings in females. Moreover, all females of Taiwanese *Paraplotes* are physogastric. Their abdomens are strongly expanded by large egg loads, such as investment of energy on the abdomen might also result in reduction of hind wings and shortened elytra. The nocturnal behavior seems to be advantageous for flightless females for survival because natural enemies are comparatively fewer during the night than those at the daytime. Beenen & Jolivet (2008) indicated that brachelytrous leaf beetles occur in alpine habitats, deserts, oceanic islands, and in some spots in tropical rainforests. The hypothesis to explain brachelytry in the former three types of habitats has been proposed. However, no reasonable explanation was provided for the situation in tropical forests—selva. Here a possible cause of brachelytry for selva is proposed: reduction of hind wings may result from the production of the physogastric females. Nocturnal behavior increases survival since natural enemies are less of a threat. Males respond in order to search for mates. Flight is less necessary at night and energy can be diverted to egg production. Brachelytry is predicted as the final outcome of this hypothesis. In Taiwan, all wingless granulines including *Apterogaleruca* Chûjô (Fig. 92), *Hirtigaleruca* Chûjô (Fig. 93), *Shaira* Maulik (Fig. 94), *Shairella* Chûjô (Fig. 95), *Taiwanolepta* Kimoto (Fig. 96), *Furusawaia* Chûjô (Fig. 97) were collected effectively at night. These observations seem to support this present hypothesis.

Lee *et al.* (2010) indicated that allopatric speciation occurred in the *Agetocera taiwana* species group, although all species are winged. All of them were restricted to mountains above 1000 m, separated from other mountains by large valleys. Only one species of *Agetocera* inhabits and is widespread in lowlands. By contrast, more species of *Paraplotes* are found and separated by different mountains and elevations. This result may reflect that dispersal of *Paraplotes* is comparatively lower due to winglessness of females.

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